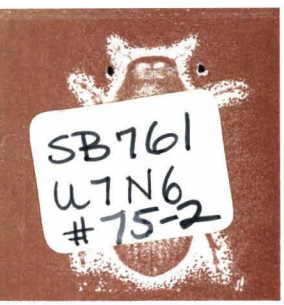
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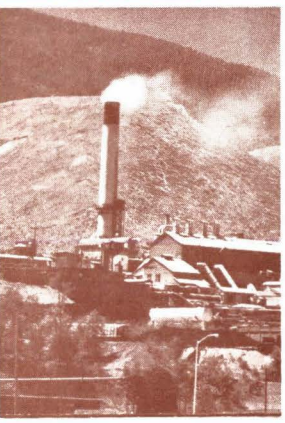

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EVALUATION OF A MOUNTAIN PINE BEETLE INFESTATION, CALX-TAMARACK CREEK DRAINAGE, FISHER RIVER RANGER DISTRICT KOOTENAI NATIONAL FOREST, MONTANA 1974

by

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ABSTRACT

Mountain pine beetle killed approximately 14,592 lodgepole pine containing an estimated 1,033,022 board feet volume from 1972 to 1974 in the Calx-Tamarack Creek drainage. This is approximately 8 percent of the lodgepole pine stand. Buildup ratios exceeded 1:1 from 1972-73 to 1974. Based on stand structure, size of trees infested, and existing green lodgepole, it is predicted that in excess of 9,000 trees will be killed in 1975. Selective logging is recommended to reduce the infestation to endemic levels.

INTRODUTION

A mountain pine beetle, *Dendroctonus ponderosa* Hopk., outbreak developed to epidemic status in lodgepole pine, *Pinus contorta* Dougl., stands in the Calx-Tamarack Creek drainage, about 20 air miles southeast of Libby, Montana (Figure 1). The infestation began in 1972 when scattered, single-tree attacks were detected over about 250 acres. In 1974, about 250 faders, occurring in groups of 2 to 10 trees per group, were mapped on approximately 320 acres. Cursory ground examination showed the ratio of trees attacked in 1974 far exceeded the number killed in 1973. The extremely dry climatic

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conditions that prevailed in 1973 may have put trees under stress for moisture resulting in an increased number of trees being attacked.

During fall 1974, the Fisher River Ranger District initiated a ground survey to determine number of trees infested, volume loss by year, and acreage involved. The District indicated there was a good possibility of salvage logging infested trees to reduce infestation potential; and that the survey would provide a basis for the salvage sales.

METHODS

A variable plot cruise (BA = 10) was conducted on 632 acres. Plots were located at 5-chain intervals on cruise lines 5 chains apart. A Spiegal Relaskop was used to tally trees from plot centers. Each tree 5 inches d.b.h. and larger occurring in the plots was recorded by species, diameter at breast height (d.b.h.), and total height. Trees were categorized into one of the following classes:

0 = green, uninfested.
1 = 1974 attack; green or partially faded foliage, brood in cambium, and blue stain present.
2 = 1973 attack; red foliage, brood emerged.
3 = 1972 or prior attack; majority of needles dropped.
4 = unsuccessful attack or pitchout; green foliage, pitch tubes present, brood and blue stain absent.

These data were analyzed by a modified Region 1 timber sales cruise program.

In addition, 20 1/10-acre circular plots were taken at 5-chain intervals on lines throughout the infestation to obtain an estimate of the phloem thickness for each d.b.h. size class 5 inches and larger. A clinometer was used to tally in and out trees in each plot. Representative phloem samples were removed with a hand axe from opposite sides of two lodgepole pines in each diameter class. Phloem thickness was measured to the nearest one-hundredth of an inch using a steel ruler.

RESULTS

The coniferous stand surveyed is highly mixed, consisting of lodgepole pine, 62.5 percent; western larch, 28.4 percent; Douglas-fir, 4.3 percent; and ponderosa pine, 2.0 percent. The remaining 2.4 percent of the stand is comprised of Engelmann spruce, grand fir, subalpine fir, western hemlock, and cottonwood. Habitat types are *Abies grandis/Clintonia uniflora* along Tamarack Creek and a mixture of *Pseudotsuga menziesii/ Linnaea borealis-Calamagrosits* phase in the remaining area. The majority of infestation is on a northeast aspect, at elevations of 3,400 to 4,000 feet.

Tree mortality and volume loss data are shown in Tables 1 and 2.

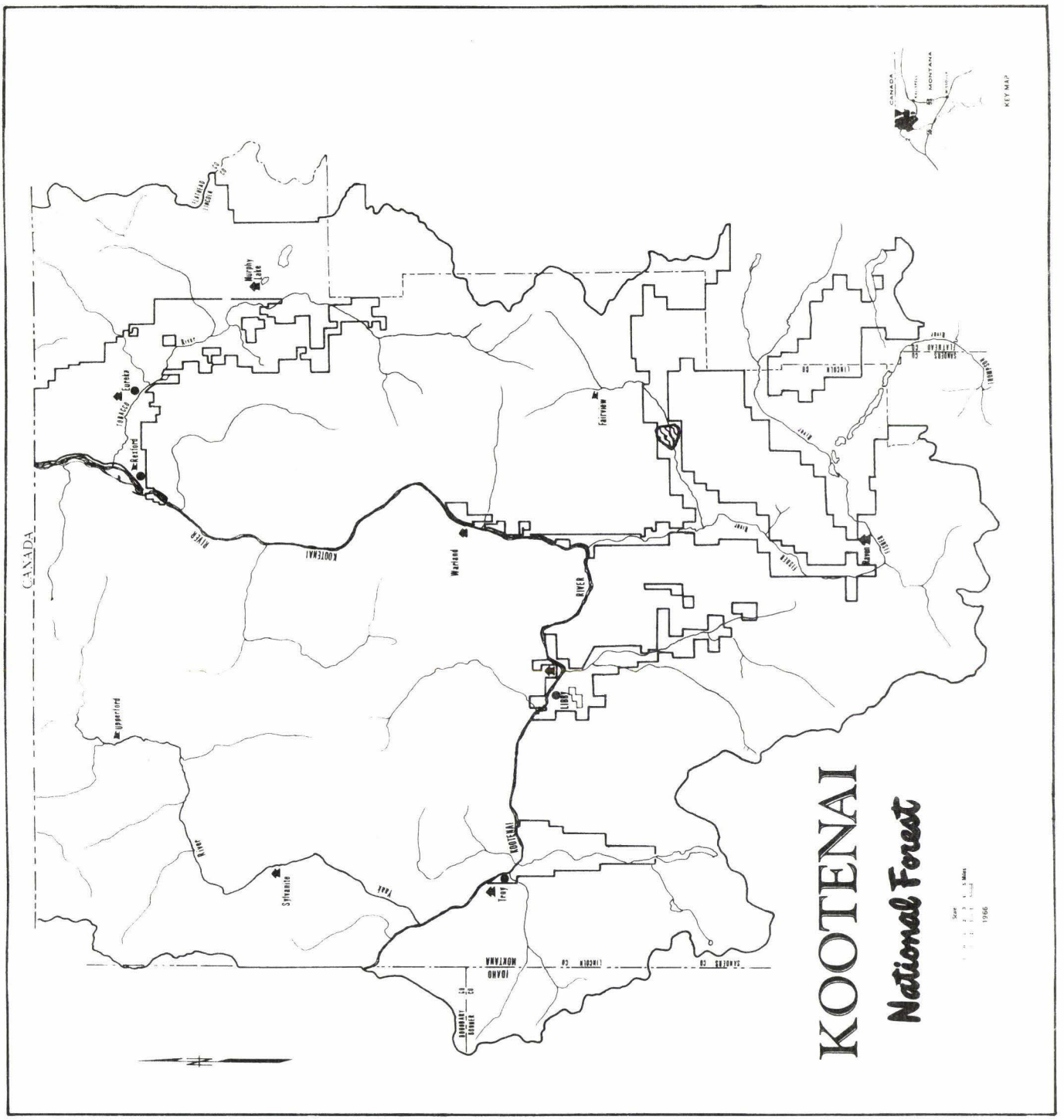

Figure 1.--Mountain pine beetle infestation, Calx-Tamarack Creek, Kootenai National Forest, 1974.

Table 1.--Estimated tree mortality, Calx-Tamarack drainage Fisher River Ranger District, Kootenai National Forest 1972-1974.

Acres surveyed	Infested trees per acre						Number of lodgepole pine killed			
	1972	Average d.b.h.	1973	Average d.b.h.	1974	Average d.b.h.	1972	1973	1974	Total
632	5.5	9	7.3	9	10.4	10	3,462	4,586	6,544	14,592

Table 2.--Estimated lodgepole pine volume loss due to mountain pine beetle, Calx-Tamarack drainage, Fisher River Ranger District, Kootenai National Forest, 1972-1974.

Volume loss/acre (board feet)			Total volume loss (board feet)			
1972	1973	1974	1972	1973	1974	Total
287	410	938	181,215	258,899	592,908	1,003,022

Estimated number of trees killed increased from 3,462 in 1972 to 4,586 in 1973 and 6,544 in 1974, making a total of 14,592 trees killed during the 3-year period. A tabulation of trees killed by d.b.h. size class per year is presented in Figure 2.

In the plots sampled tree mortality occurred in all diameter classes from 5 to 20 inches with the exception of the 18- and 19-inch diameters. From 1972 through 1974, greatest mortality occurred in the 9- to 12-inch diameter classes.

Approximately 1.8 percent of the lodgepole pine type 5-inch d.b.h. and larger was killed in 1972, 2.5 percent in 1973, and 3.7 percent in 1974, making a total of 8.0 percent over the 3-year period.

Average diameter of infested trees was 9 inches in 1972 and 1973, and 10 inches in 1974. In 1972, 3.8 percent of the trees killed were 12 inches d.b.h. and larger; in 1973, 30.1 percent of the trees were 12 inches d.b.h. and larger, and in 1974, 74.2 percent of the trees killed were 12 inches d.b.h. and larger in size.

Phloem measurement data collected within this stand are shown in Table 3. Phloem thickness ranged from 0.02 to 0.13 inch in the trees measured. Of all the trees inventoried during 1974, 2.9 percent were 12 inches d.b.h. and greater and had a phloem thickness of 0.11 inch thick. Approximately 7.3 percent of the remaining lodgepole stand is 12 inches d.b.h. and larger in size. Of all phloem samples taken from trees 5 inches d.b.h. and larger, 6.5 percent had a phloem thickness greater than or equal to 0.11 inch thick.

Figure 2. Tabulation of trees killed by D B H size class per year 1972-1974, Calx-Tamarack drainage, Kootenai National Forest.

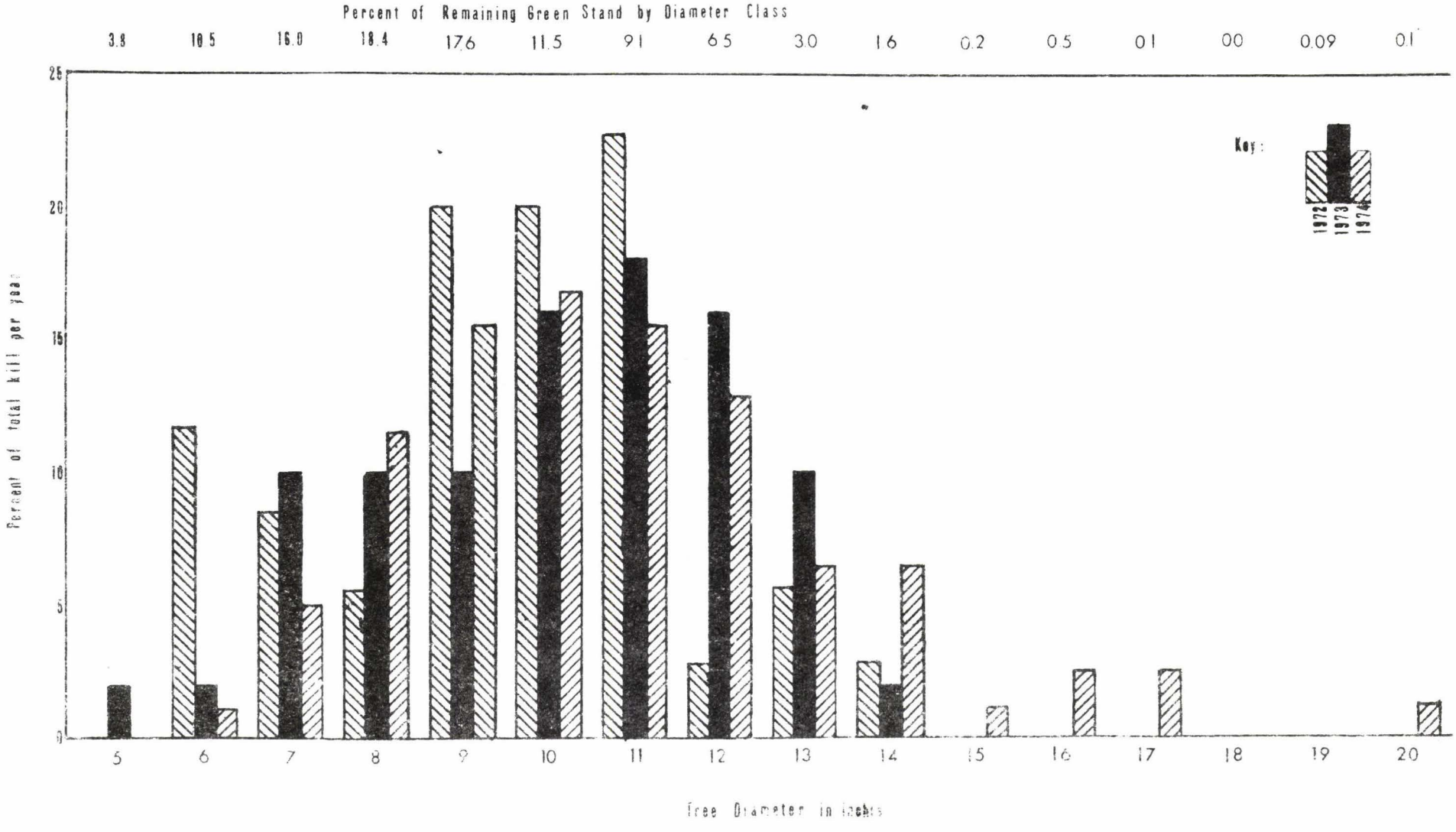

Table 3.--Summary of data from phloem measurements of lodgepole pine, Calx-Tamarack mountain pine beetle infestation, 1974.

D.b.h.	Mean	Standard deviation	Standard error
5	0.053	0.021	0.006
6	.054	.019	.003
7	.054	.017	.003
8	.060	.017	.002
9	.070	.021	.003
10	.081	.017	.003
11	.075	.017	.003
12	.090	.017	.004
13	.080	.023	.008
14	.085	.020	.008
15	.083	.015	.008

Approximately 6.8 percent of the trees attacked since 1972 were attacked unsuccessfully. That is, beetles were unsuccessful in constructing galleries and depositing eggs. Whether these trees are resistant or were not attacked by a sufficient number of beetles to kill the trees isn't known at this time.

DISCUSSION

The mountain pine beetle outbreak in the Calx-Tamarack drainage began in 1972 and more than doubled by 1974. Infested trees per acre increased from 5.5 in 1972 to 10.4 in 1974. Buildup ratio of old to newly attacked trees was 1:1.3 from 1972 to 1973, and 1:1.4 from 1973 to 1974. Average d.b.h. of infested trees also increased from 1972 to 1974.

Data collected during past mountain pine beetle outbreaks show that the number of trees killed is dependent on beetle population which is affected by (1) phloem thickness, (2) diameter classes, (3) stand density, and (4) habitat types (Cole, 1973).

Mountain pine beetle prefer larger diameter trees each year as well as over the life of an infestation (Gibson, 1943; Hopping and Beall, 1948; Cole and Amman, 1969). Reid (1963) also observed that beetle survival increased with tree diameter. Our data shows that as this infestation progressed, the mountain pine beetle killed progressively more trees 12 inches in diameter and larger yearly.

Phloem thickness is considered the principal factor regulating brood production of the mountain pine beetle in lodgepole pine stands when temperatures are optimum for beetle development (Amman, 1969). Also, brood production is positively correlated with phloem thickness and

phloem thickness is positively correlated with tree diameter (Amman, 1969; 1972). Cole and Cahill (In press) concluded that the distribution of phloem thickness over diameter becomes an effective measurement for evaluating infestation potential in a stand. In the phloem samples taken, 2.9 percent of the trees 12 inches d.b.h. and larger had phloem greater than or equal to 0.11 inch thick. By including trees 11 inches d.b.h. and larger the percent did not increase. When we included trees 10 inches d.b.h. and larger with a phloem thickness greater than or equal to 0.11 inch the percent increased to 5.3, and by including the 9-inch d.b.h. and larger trees it increased to 5.9. Based on these data, by removing all trees 9 inches d.b.h. and larger from the stand, we would reduce the potential for additional infestation by 3.0 percent.

However, based on the buildup ratios from 1972 to 1974, and on the formula $Y^1 = y + bx$ (Baker, 1968) where

Y = the potential cumulative number of trees killed predicted through next year (1975).

y = the cumulative number trees killed through this year

x = number of trees killed this year

x_1 = number of trees killed last year

$b = \frac{x}{x_1}$

it is predicted that 9,292 trees will be killed in the Calx-Tamarack infestation in 1975.

As larger diameter trees (12 inches and greater) are removed from the stand, either by the beetles or by logging, the outbreak should begin to decline. Thinner phloem trees produce fewer beetles, and beetles that complete development in thin-phloem small trees are usually smaller than those completing development in larger trees (Safranyik and Jahren, 1970). As a result of phloem being thinner and beetles being smaller, we would expect that fewer eggs would be deposited (Amman, 1972). However, sufficient large diameter lodgepole pine exist in the drainage to continue the outbreak for several years.

Although 37.5 percent of the stand is composed of species other than lodgepole pine, we do not believe a sufficient amount of mixed tree species exists to alter the course of the outbreak. Amman and Baker (1972) concluded that the proportion of other tree species would have to be considerably more than 36 percent in the elevational zone of optimal beetle development for lodgepole pine in a mixed species forest to be less susceptible to mountain pine beetle damage. Flint (1924) and Roe and Amman (1970) found no difference in susceptibility of lodgepole pine in mixed than in pure stands to mountain pine beetle attacks.

RECOMMENDATIONS

Several alternatives are available for mountain pine beetle suppression. These are:

1. Chemical control

    a. Treat infested trees with ethylene dibromide by mixing 56 percent concentrate to 1 part of solution to 19 parts diesel oil.

    b. Use Lindane, generally obtained as a 20 percent emulsifiable concentrate mixed with fuel oil in a ratio of 1 part concentrate to 14 parts of oil.

    Each material is applied with a low-pressure sprayer to individually felled trees.

2. Silvicultural practices

    a. Fell and burn infested trees

    b. Salvage log infested trees

    c. Selectively log to remove infested trees and those trees 12 inches d.b.h. and larger from the stand.

Applied suppression is not recommended for this infestation. Even though these techniques have been successful in some outbreaks, they usually serve as a holding action and do not reduce infestations to endemic status. Amman and Baker (1972) found that beetle populations declined in approximately the same number of years in both treated and untreated stands.

Salvage logging only infested trees will not alter the susceptibility of the stand.

By logging infested and beetle generator trees (i.e., trees 9.0 inches and greater d.b.h. having 0.11 inch phloem) the stand structure can possibly be altered resulting in a beetle population decline.

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